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Hoshino

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(54) **ROTARY COMPRESSOR**

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(Continued)

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CPC .. F04C 23/008; F04C 18/3564; F04C 29/023; F04C 29/028; F04C 29/025; F04C 29/02; F04C 2240/603; F04C 18/322
See application file for complete search history.

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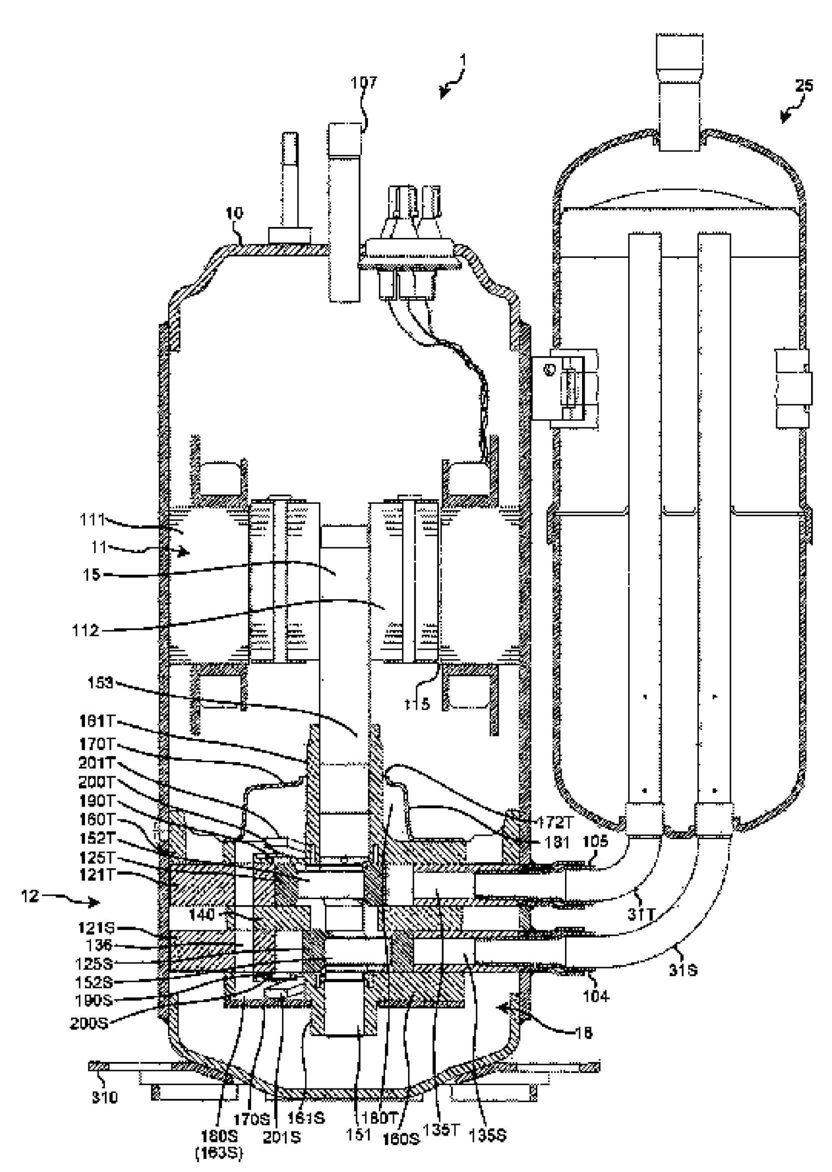
(74) *Attorney, Agent, or Firm* — Paratus Law Group, PLLC

(57) **ABSTRACT**

A rotary compressor includes: a compressor housing stores lubricating oil; a compression unit compresses the refrigerant; and a motor drives the compression unit. The compression unit includes a cylinder, an upper end plate and a lower end plate, a main bearing provided on the upper end plate, a sub bearing provided on the lower end plate, a rotary shaft supported by the main bearing and the sub bearing, and a piston fitted to the rotary shaft. An inner peripheral surface of a shaft hole of the sub bearing is provided with an oil-supply groove having a helical shape that supplies the lubricating oil from a lower end to an upper end of the shaft hole, and the oil-supply groove is inclined with respect to the
(Continued)



rotary shaft in a rotating direction and extends from the lower end toward the upper end of the rotary shaft in the rotating direction.

7 Claims, 7 Drawing Sheets

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F04C 29/02 (2006.01)
F04C 18/32 (2006.01)

(52) **U.S. Cl.**
CPC *F04C 29/028* (2013.01); *F04C 2210/26* (2013.01); *F04C 2240/30* (2013.01); *F04C 2240/40* (2013.01); *F04C 2240/60* (2013.01)

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FIG.1

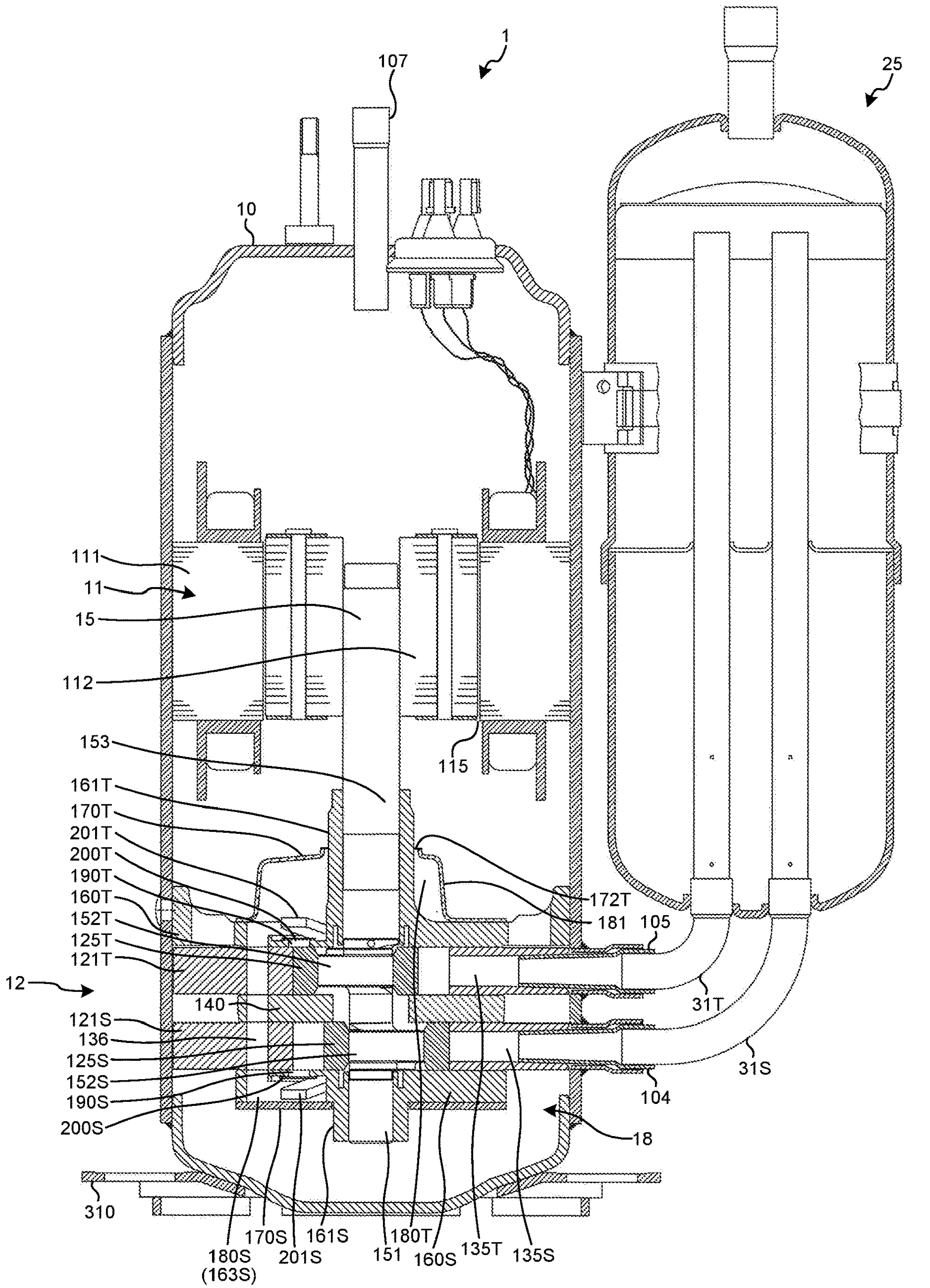

1
107
25
10
111
11
15
112
153
115
161T
170T
201T
200T
190T
160T
152T
125T
121T
172T
181
105
12
140
31T
121S
136
125S
152S
190S
200S
31S
104
18
310
170S
161S
180S
(163S)
201S
151
180T
160S
135T
135S

FIG.2

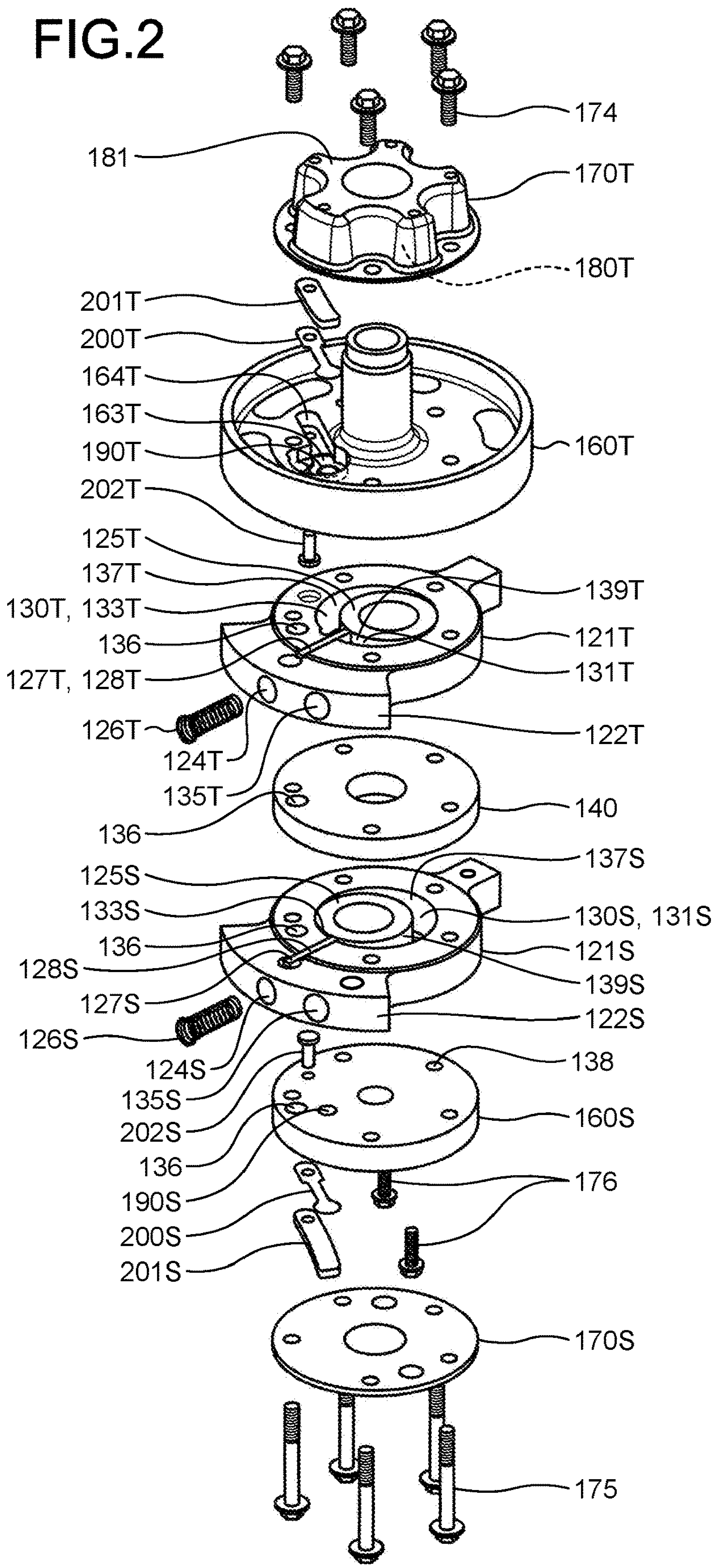
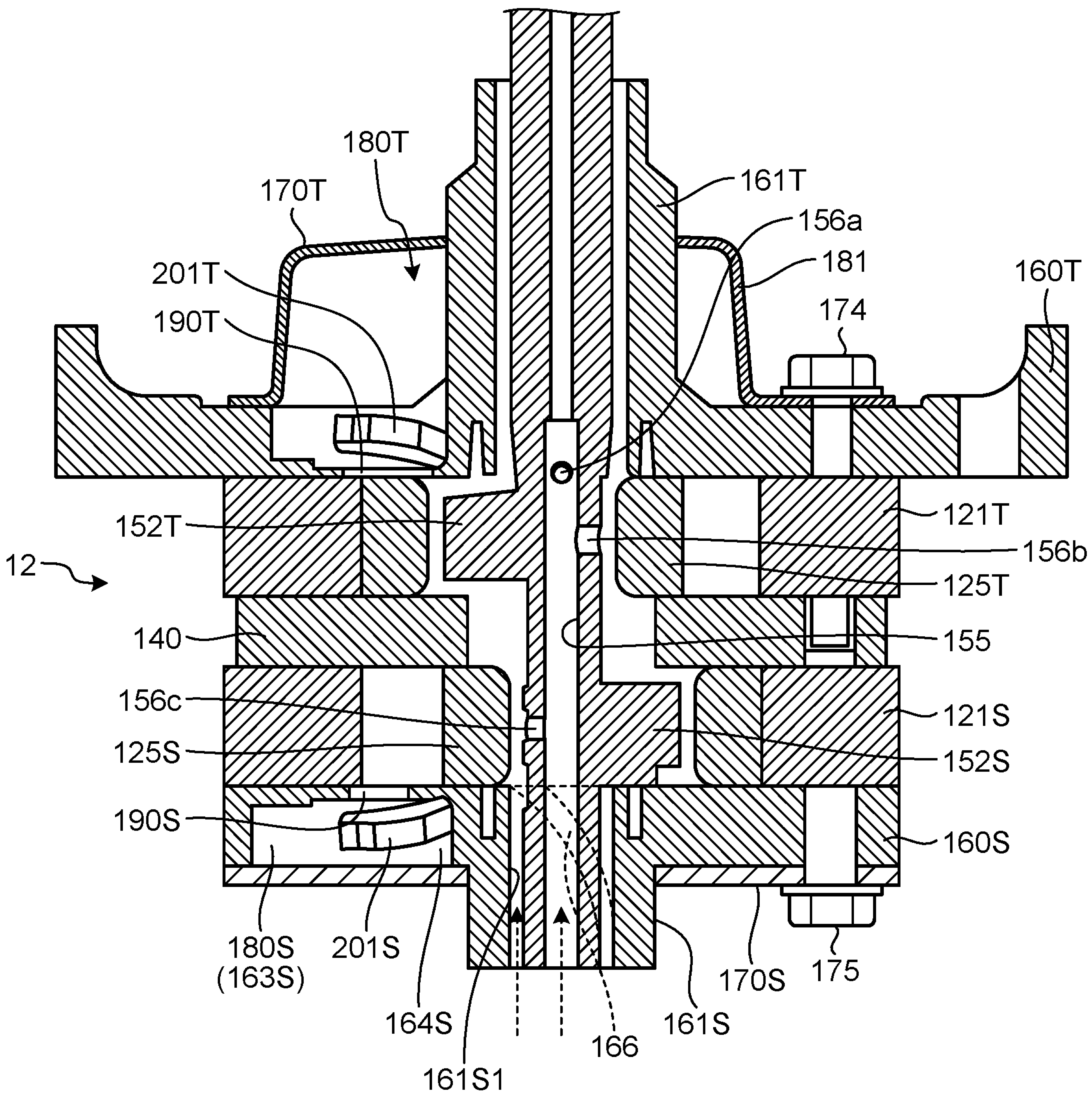

174
181
170T
180T
201T
200T
164T
163T
190T
202T
160T
125T
137T
130T, 133T
136
127T, 128T
139T
121T
131T
126T
124T
135T
122T
136
140
125S
133S
136
128S
127S
126S
137S
130S, 131S
121S
139S
122S
124S
135S
202S
136
190S
200S
201S
138
160S
176
170S
175

FIG.3



180T
170T
161T
156a
181
160T
201T
174
190T
152T
121T
156b
12
125T
140
155
156c
121S
125S
152S
190S
160S
180S
(163S)
201S
170S
175
164S
166
161S
161S1

FIG.4

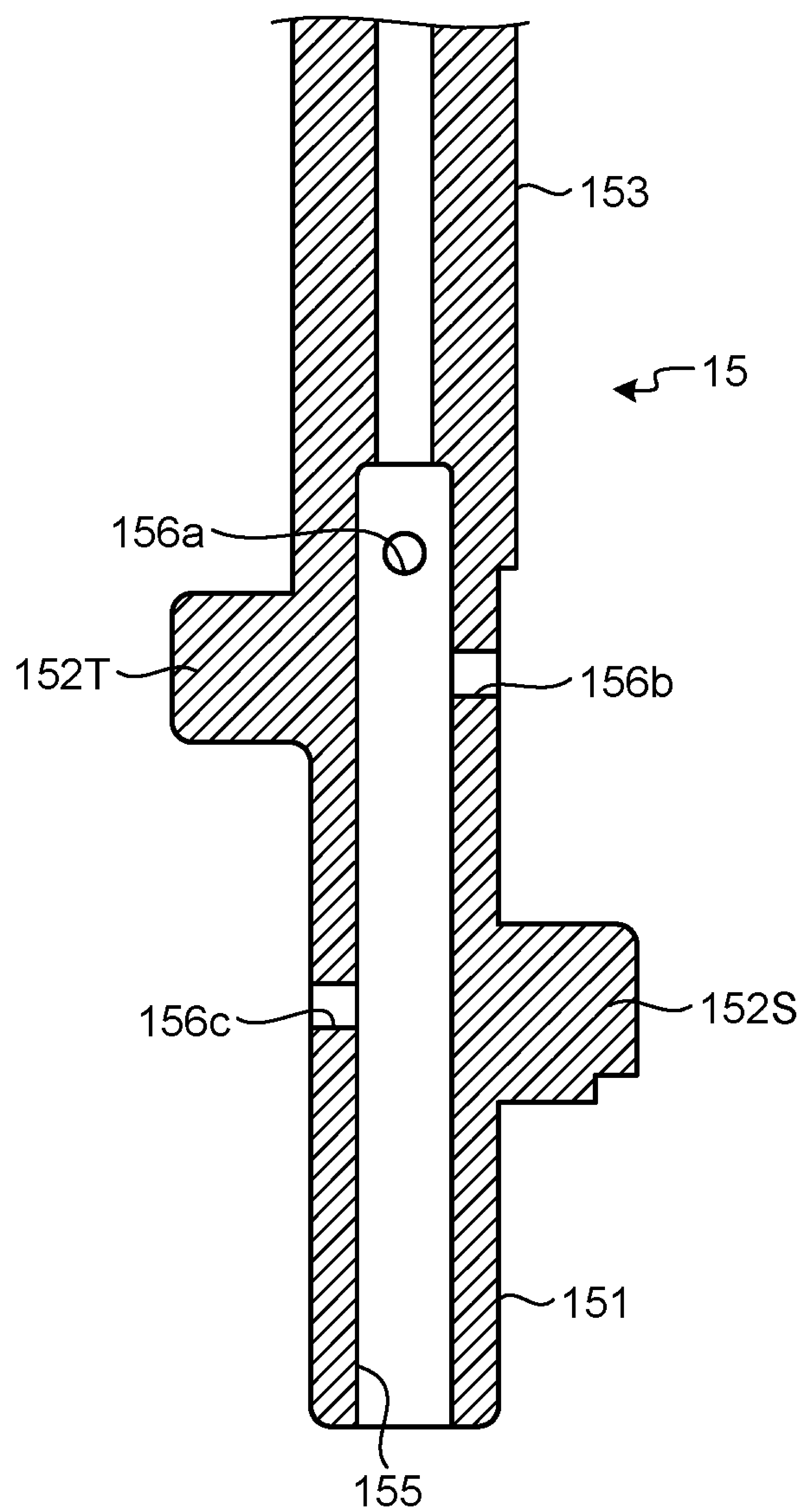


FIG.5A

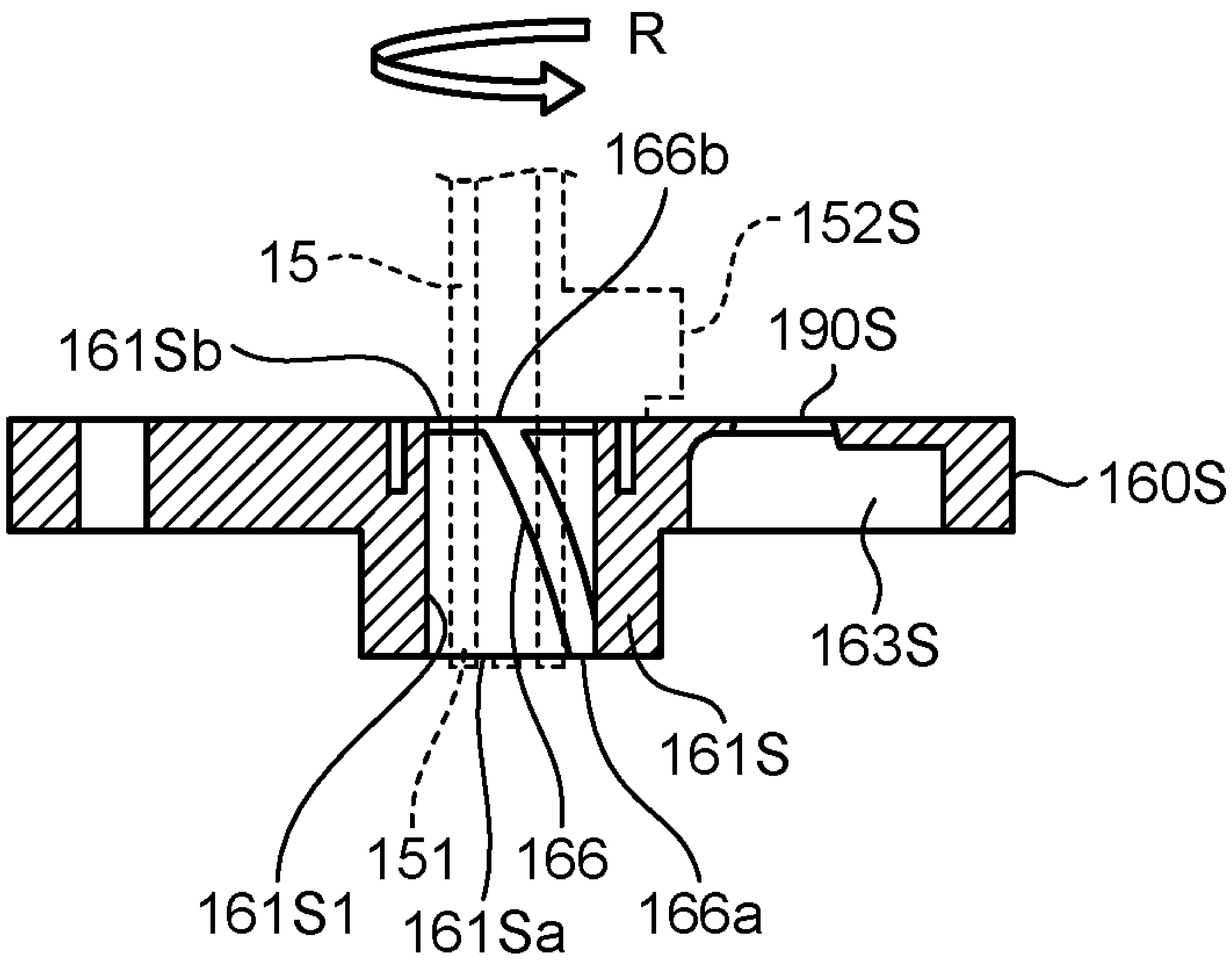

R
166b
152S
15
161Sb
190S
160S
163S
161S
151
166
161S1
161Sa
166a

FIG.5B

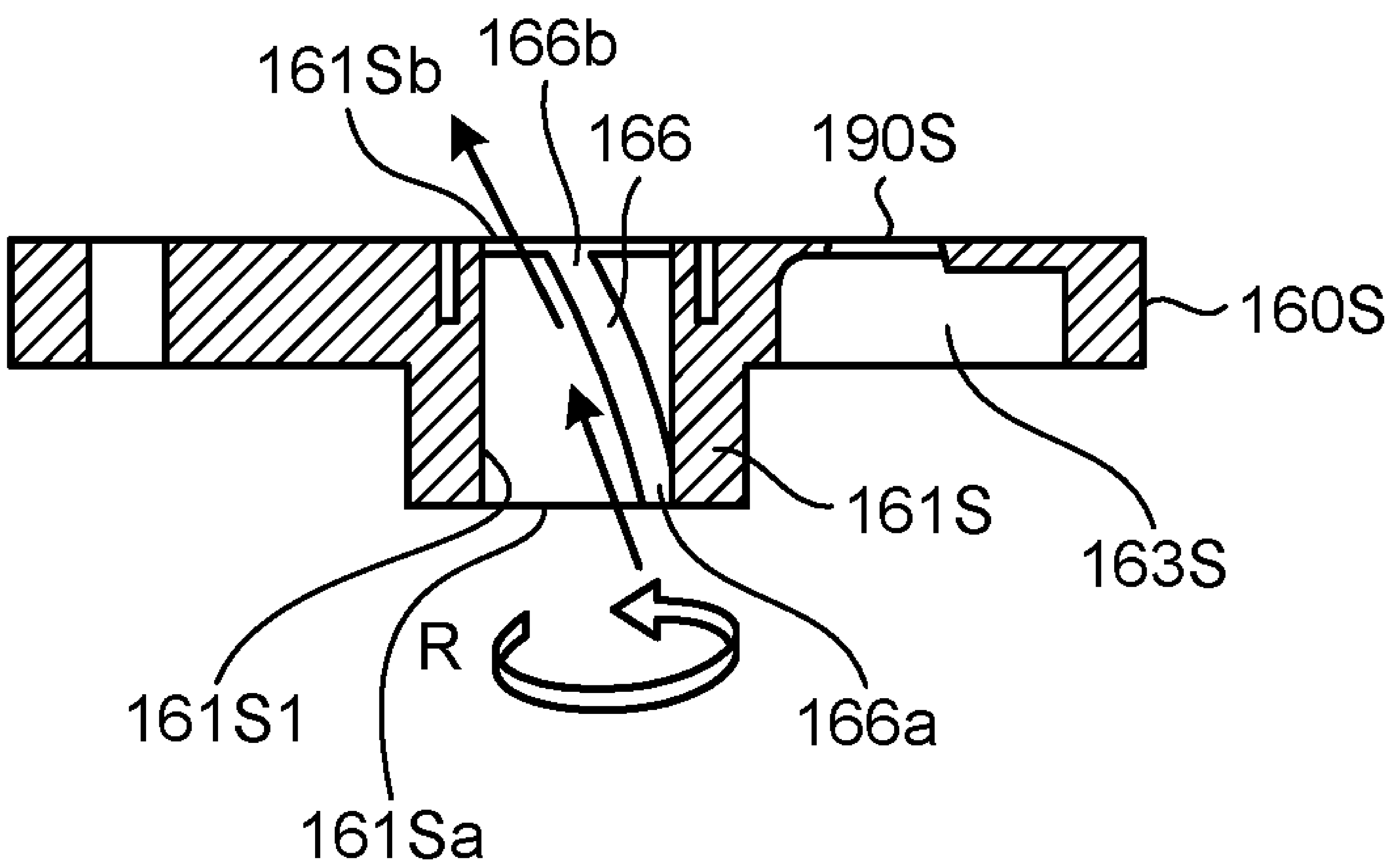

161Sb
166b
166
190S
160S
161S
163S
R
161S1
166a
161Sa

FIG.6

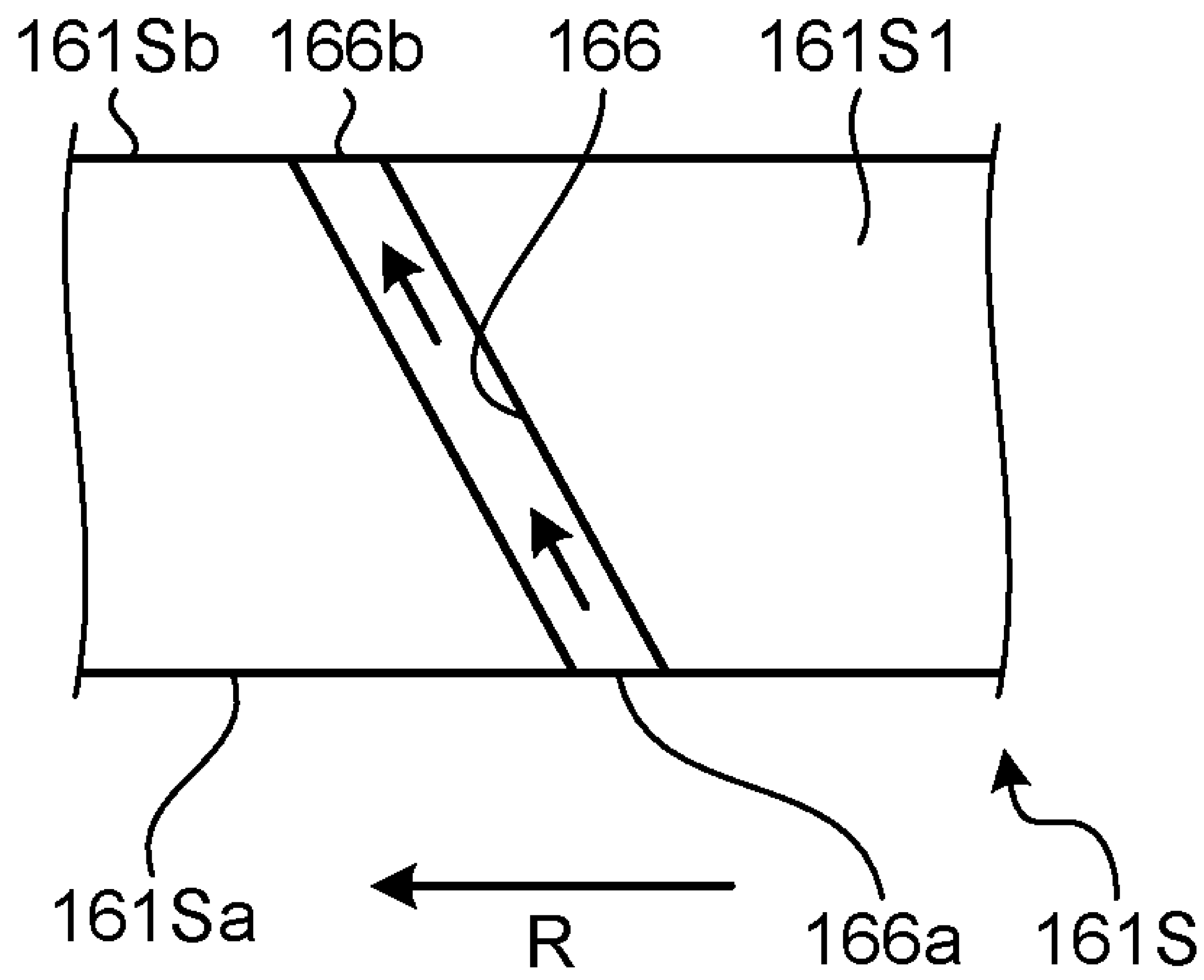

161Sb
166b
166
161S1
161Sa
R
166a
161S

FIG.7

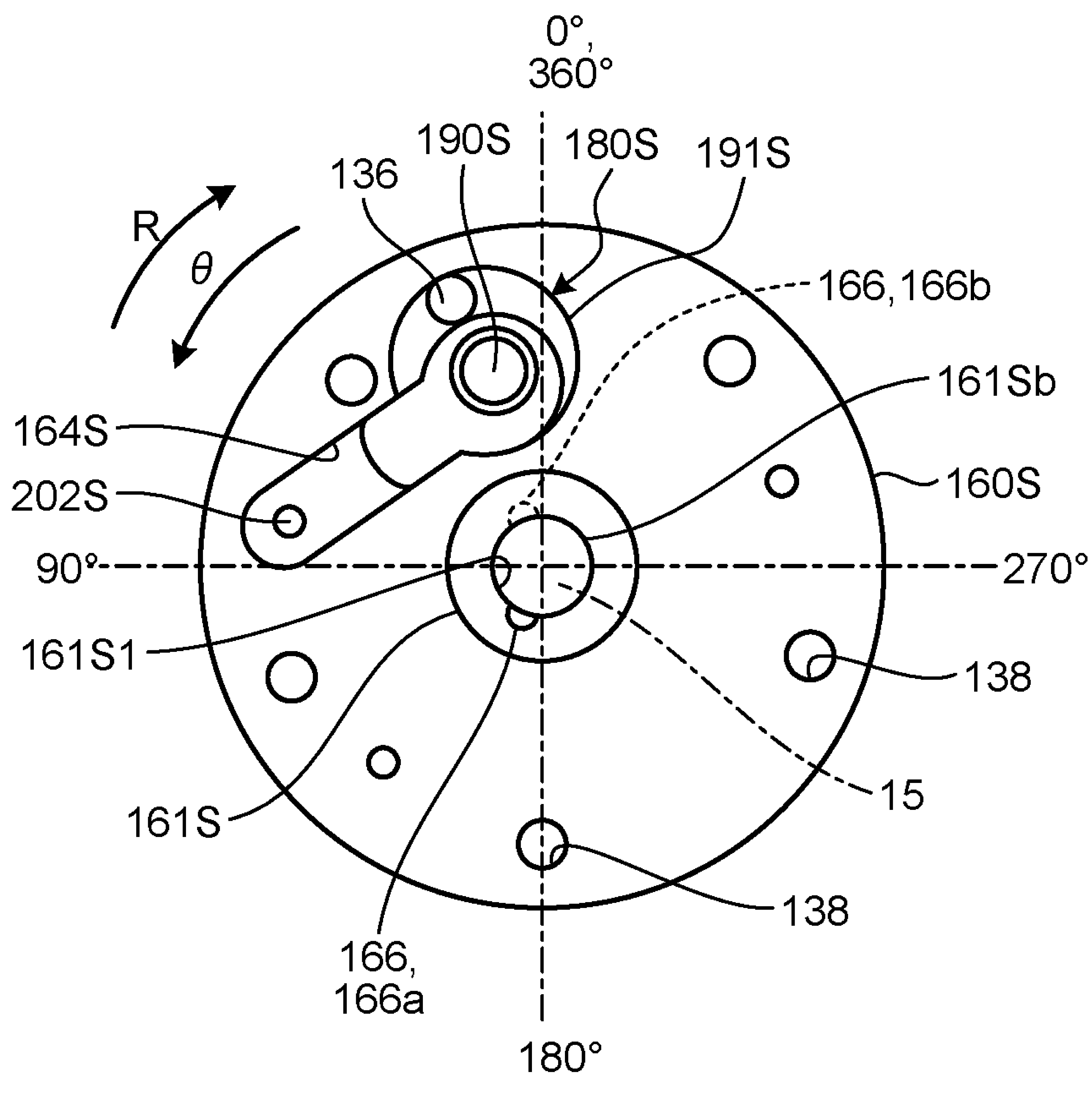
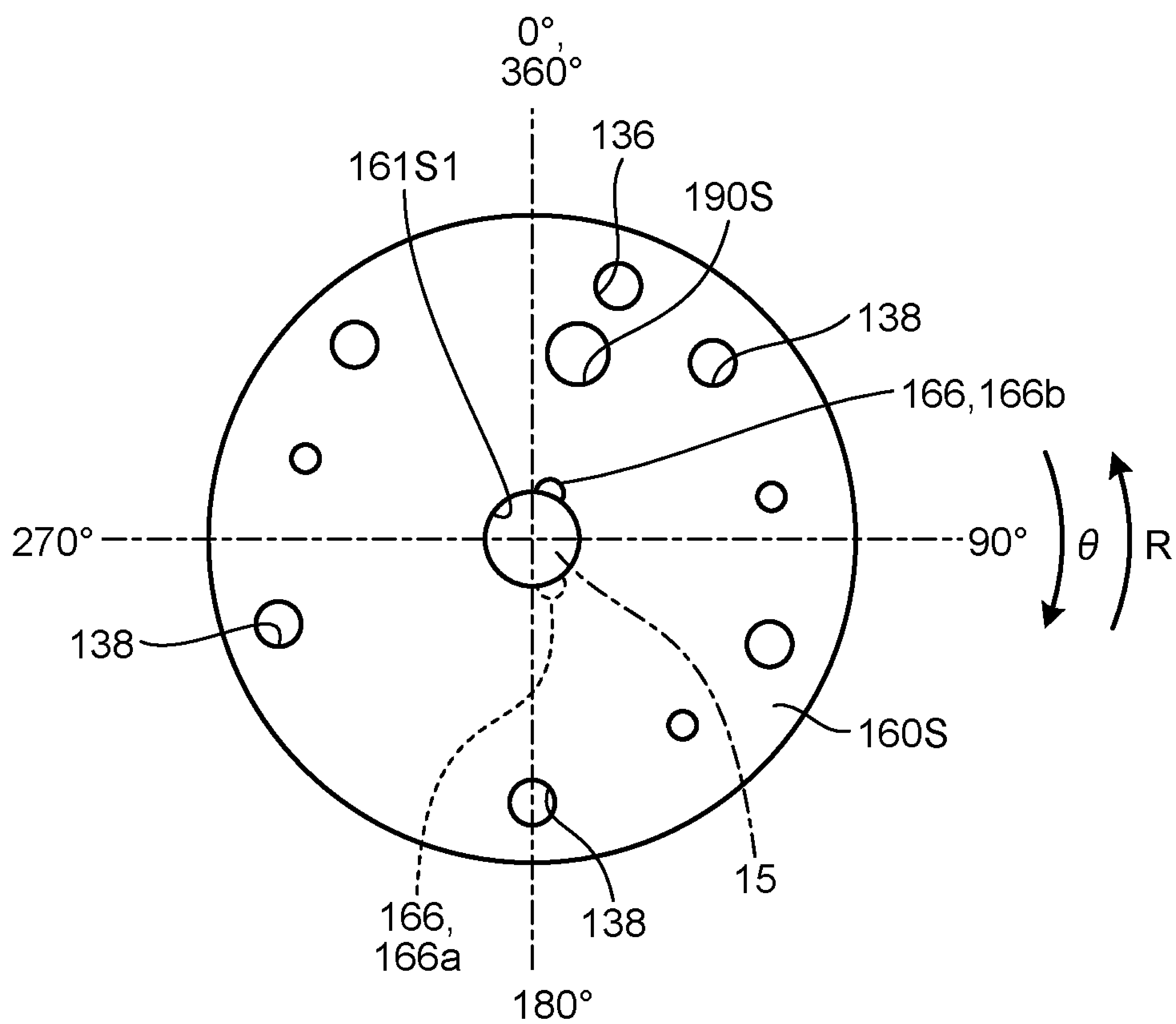

0°,
360°
190S
180S
191S
136
R
θ
166,166b
161Sb
164S
202S
160S
90°
270°
161S1
138
15
161S
138
166,
166a
180°

FIG.8


0°,
360°
136
161S1
190S
138
166,166b
270°
90°
θ
R
138
160S
15
166,
166a
138
180°

ROTARY COMPRESSOR

CROSS REFERENCE TO PRIOR APPLICATION

This application is a National Stage Patent Application of PCT International Patent Application No. PCT/JP2019/005121 (filed on Feb. 13, 2019) under 35 U.S.C. § 371, which claims priority to Japanese Patent Application No. 2018-076929 (filed on Apr. 12, 2018), which are all hereby incorporated by reference in their entirety.

FIELD

The present invention relates to a rotary compressor.

BACKGROUND

There is a known rotary compressor having a structure in which lubricating oil stored in a lower part of a compressor housing is sucked up from an oil-supply vertical hole inside a rotary shaft and then supplied to the sliding portions such as a compression unit from an oil-supply lateral hole communicating with the oil-supply vertical hole. In such a structure, the lubricating oil ensures the lubricity of the sliding portions and seals the inside of the cylinder of the compression unit.

When supplying lubricating oil through the oil-supply vertical hole inside the rotary shaft, centrifugal pump action works inside the oil-supply vertical hole to suck up the lubricating oil from the lower end of the rotary shaft to the oil-supply lateral hole along the oil-supply vertical hole. This type of rotary compressor sometimes has a structure in which the lubricating oil supplied from the oil-supply lateral hole to the sliding portions flows downward along an outer peripheral surface of the rotary shaft, thereby supplying the lubricating oil to the sliding portions of the sub bearing.

A certain rotary compressor among the related art supplies the lubricating oil to the sliding portions by using an oil-supply groove provided helically on the outer peripheral surface of the rotary shaft in addition to the oil-supply vertical hole inside the rotary shaft. When the lubricating oil is supplied along the oil-supply groove of the rotary shaft, the lubricating oil is sucked up along the oil-supply groove of the rotary shaft by the viscous pump action that utilizes the viscosity of the lubricating oil that exists between the inner peripheral surface of the sub bearing and the outer peripheral surface of the rotary shaft.

CITATION LIST

Patent Literature

Patent Literature 1: JP 10-47281 A

SUMMARY

Technical Problem

In a case where the shaft diameter of the rotary shaft is small or where the rotation speed of the rotary shaft is low at the time of supplying lubricating oil through the oil-supply vertical hole of the rotary shaft, the centrifugal force generated in the lubricating oil inside the oil-supply vertical hole of the rotary shaft is reduced, leading to a decrease in the amount of lubricating oil supplied through the oil-supply vertical hole and the oil-supply lateral hole. This might lead to the reduction of the amount of lubricating oil supplied to the sliding portions of the compression unit and the bearing. This would also decrease the sealability provided by the lubricating oil in the cylinder of the compression unit, leading to the leak of the gas under compression from the compression chamber to the suction chamber, resulting in deterioration of the performance of the rotary compressor. Furthermore, it is difficult to compensate for the reduction in the supply amount of the lubricating oil only by providing the oil-supply groove on the rotary shaft.

The disclosed technique is made in view of the above and aims to provide a rotary compressor capable of stably supplying lubricating oil to the sliding portions.

Solution to Problem

A rotary compressor disclosed in this application, according to an aspect, includes: a compressor housing hermetically sealed, having a cylindrical shape to be vertically arranged, being provided with a discharge unit and a suction unit of refrigerant, and configured to store lubricating oil in a lower part of the compressor housing; a compression unit disposed at a lower part of the compressor housing and configured to compress the refrigerant sucked from the suction unit and discharge the compressed refrigerant from the discharge unit; and a motor disposed on an upper part of the compressor housing and configured to drive the compression unit, the compression unit including a cylinder having an annular shape, an upper end plate that closes an upper side of the cylinder, a lower end plate that closes a lower side of the cylinder, a main bearing provided on the upper end plate, a sub bearing provided on the lower end plate, a rotary shaft supported by the main bearing and the sub bearing so as to be rotated by the motor, and a piston having an annular shape, and configured to be fitted to an eccentric part of the rotary shaft and to revolve along an inner peripheral surface of the cylinder so as to form a cylinder chamber within the cylinder, wherein an inner peripheral surface of a shaft hole of the sub bearing is provided with an oil-supply groove having a helical shape that supplies the lubricating oil from a lower end to an upper end of the shaft hole, and the oil-supply groove is inclined with respect to the rotary shaft in a rotating direction and extends from the lower end toward the upper end of the rotary shaft in the rotating direction.

Advantageous Effects of Invention

According to one aspect of the rotary compressor disclosed in the present application, it is possible to stably supply the lubricating oil to the sliding portions.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a vertical cross-sectional view illustrating a rotary compressor of an exemplary embodiment.

FIG. **2** is an exploded perspective view illustrating a compression unit of the rotary compressor of the exemplary embodiment.

FIG. **3** is a vertical cross-sectional view illustrating a main part of the compression unit of the rotary compressor of the exemplary embodiment.

FIG. **4** is a vertical cross-sectional view illustrating a rotary shaft of the rotary compressor of the exemplary embodiment.

FIG. **5**A is a vertical cross-sectional view illustrating an oil-supply groove of a sub bearing of the rotary compressor of the exemplary embodiment.

FIG. **5**B is a vertical cross-sectional view illustrating the oil-supply groove of the sub bearing of the rotary compressor of the exemplary embodiment.

FIG. **6** is a schematic developed view illustrating an inner peripheral surface of a shaft hole of the sub bearing of the rotary compressor of the exemplary embodiment.

FIG. **7** is a bottom plan view of the sub bearing of a lower end plate of the rotary compressor of the exemplary embodiment.

FIG. **8** is a top plan view of the sub bearing of the lower end plate of the rotary compressor of the exemplary embodiment.

DESCRIPTION OF EMBODIMENTS

Exemplary embodiments of the rotary compressor disclosed in the present application will be described below in detail with reference to the drawings. The rotary compressor disclosed in the present application is not limited to the exemplary embodiments described below.

Exemplary Embodiment

(Configuration of Rotary Compressor)

FIG. **1** is a vertical cross-sectional view illustrating a rotary compressor of an exemplary embodiment. FIG. **2** is an exploded perspective view illustrating a compression unit of the rotary compressor of the exemplary embodiment.

As illustrated in FIG. **1**, a rotary compressor **1** includes a compression unit **12** disposed at a lower part of a compressor housing **10** that is hermetically sealed and has a cylindrical shape to be vertically arranged, a motor **11** disposed on an upper part of the compressor housing **10** and configured to drive the compression unit **12** via a rotary shaft **15**, and an accumulator **25** that is hermetically sealed, has a cylindrical shape to be vertically arranged, and is fixed to an outer peripheral surface of the compressor housing **10**.

The compressor housing **10** includes an upper suction pipe **105** and a lower suction pipe **104** for sucking the refrigerant, and the upper suction pipe **105** and the lower suction pipe **104** are provided on the lower side surface of the compressor housing **10**. The accumulator **25** is connected to an upper cylinder chamber **130**T (refer to FIG. **2**) of an upper cylinder **121**T via the upper suction pipe **105** and an accumulator upper bending pipe **31**T serving as a suction unit, and is connected to a lower cylinder chamber **130**S (refer to FIG. **2**) of a lower cylinder **121**S via the lower suction pipe **104** and an accumulator lower bending pipe **31**S serving as a suction unit. In the present exemplary embodiment, the upper suction pipe **105** and the lower suction pipe **104** overlap each other in the circumferential direction of the compressor housing **10** so as to be located at the same position.

The motor **11** includes a stator **111** disposed on the outside and a rotor **112** disposed on the inside. The stator **111** is fixed to the inner peripheral surface of the compressor housing **10** by shrink fitting or welding. The rotor **112** is fixed to the rotary shaft **15** by shrink fitting.

On the rotary shaft **15**, a sub shaft **151** below a lower eccentric part **152**S is rotatably supported by a sub bearing **161**S provided on a lower end plate **160**S, and a main shaft **153** below an upper eccentric part **152**T is rotatably supported by a main bearing **161**T provided on an upper end plate **160**T. The rotary shaft **15** is provided with the upper eccentric part **152**T and the lower eccentric part **152**S with a phase difference of 180° from each other. On the rotary shaft **15**, an upper piston **125**T is supported on the upper eccentric part **152**T, and a lower piston **125**S is supported on the lower eccentric part **152**S. With this configuration, while being rotatably supported with respect to the entire compression unit **12**, the rotary shaft **15** causes an outer peripheral surface **139**T of the upper piston **125**T to revolve along an inner peripheral surface **137**T of the upper cylinder **121**T and causes an outer peripheral surface **139**S of the lower piston **125**S to revolve along an inner peripheral surface **137**S of the lower cylinder **121**S.

In the lower part of the compressor housing **10**, lubricating oil **18** for ensuring the lubricity of sliding portions configured to slide in the compression unit **12**, such as between the upper cylinder **121**T and the upper piston **125**T and between the lower cylinder **121**S and the lower piston **125**S as well as sealing (enclosing) an upper compression chamber **133**T (refer to FIG. **2**) and a lower compression chamber **133**S (refer to FIG. **2**), is sealed in an amount that substantially immerses the entire compression unit **12**. On the lower side of the compressor housing **10**, a mounting leg **310** (refer to FIG. **1**) that locks a plurality of elastic supporting members (not illustrated), which supports the entire rotary compressor **1**, is fixed.

As illustrated in FIG. **1**, the compression unit **12** compresses the refrigerant sucked from the upper suction pipe **105** and the lower suction pipe **104**, and then discharges the refrigerant from a discharge pipe **107** described below. As illustrated in FIG. **2**, the compression unit **12** has a stacked structure including, in the order from the top, an upper end plate cover **170**T having a bulging part **181** with a hollow space formed therein, the upper end plate **160**T, an upper cylinder **121**T having an annular shape, an intermediate partition plate **140**, a lower cylinder **121**S having an annular shape, the lower end plate **160**S, and a lower end plate cover **170**S having a flat plate shape. The entire compression unit **12** is fixed by a plurality of through bolts **174** and **175** each of which being disposed on a substantially concentric circle from above and below, and by auxiliary bolts **176**.

The upper cylinder **121**T has the inner peripheral surface **137**T having a cylindrical shape. The upper piston **125**T having an outer diameter smaller than the inner diameter of the inner peripheral surface **137**T of the upper cylinder **121**T is disposed inside the inner peripheral surface **137**T of the upper cylinder **121**T. The upper compression chamber **133**T for sucking, compressing, and discharging the refrigerant is formed between the inner peripheral surface **137**T of the upper cylinder **121**T and the outer peripheral surface **139**T of the upper piston **125**T. The inner peripheral surface **137**S having a cylindrical shape is formed in the lower cylinder **121**S. The lower piston **125**S having an outer diameter smaller than the inner diameter of the inner peripheral surface **137**S of the lower cylinder **121**S is disposed inside the inner peripheral surface **137**S of the lower cylinder **121**S. The lower compression chamber **133**S for sucking, compressing, and discharging the refrigerant is formed between the inner peripheral surface **137**S of the lower cylinder **121**S and the outer peripheral surface **139**S of the lower piston **125**S.

As illustrated in FIG. **2**, the upper cylinder **121**T includes an upper protrusion **122**T protruding from the outer peripheral portion to the outer peripheral side of the cylindrical inner peripheral surface **137**T in the radial direction. The upper protrusion **122**T is provided with an upper vane slot **128**T that extends radially outward from the upper cylinder chamber **130**T. Inside the upper vane slot **128**T, an upper vane **127**T is slidably disposed. The lower cylinder **121**S includes a lower protrusion **122**S protruding from the outer peripheral portion to the outer peripheral side of the cylindrical inner peripheral surface **137**S in the radial direction. The lower protrusion **122**S is provided with a lower vane slot **128**S that extends radially outward from the lower cylinder chamber **130**S. Inside the lower vane slot **128**S, a lower vane **127**S is slidably disposed.

The upper protrusion **122**T is formed over a predetermined range along the inner peripheral surface **137**T of the upper cylinder **121**T in the circumferential direction. The lower protrusion **122**S is formed over a predetermined range along the inner peripheral surface **137**S of the lower cylinder **121**S in the circumferential direction. The upper protrusion **122**T and the lower protrusion **122**S are used as chuck holders to fix the upper cylinder **121**T and the lower cylinder **121**S to the processing jig during processing. By fixing the upper protrusion **122**T and the lower protrusion **122**S to the processing jig, the upper cylinder **121**T and the lower cylinder **121**S are positioned at predetermined positions.

The upper protrusion **122**T is provided with an upper spring hole **124**T at a position overlapping the upper vane slot **128**T at a depth not penetrating to reach the upper cylinder chamber **130**T, from the outer side surface. An upper spring **126**T is disposed in the upper spring hole **124**T. The lower protrusion **122**S is provided with a lower spring hole **124**S at a position overlapping the lower vane slot **128**S at a depth not penetrating to reach the lower cylinder chamber **130**S, penetrating from the outer side surface. A lower spring **126**S is disposed in the lower spring hole **124**S.

Furthermore, the upper cylinder **121**T is provided with an upper pressure introduction channel **129**T that allows communication between the outside of the upper vane slot **128**T in the radial direction and the inside of the compressor housing **10** through an opening to introduce the compressed refrigerant in the compressor housing **10** and apply a back pressure generated by the pressure of the refrigerant to the upper vane **127**T. Furthermore, the lower cylinder **121**S is provided with a lower pressure introduction channel **129**S that allows communication between the outside of the lower vane slot **128**S in the radial direction and the inside of the compressor housing **10** through an opening to introduce the compressed refrigerant in the compressor housing **10** and apply a back pressure generated by the pressure of the refrigerant to the lower vane **127**S.

The upper protrusion **122**T of the upper cylinder **121**T is provided with an upper suction hole **135**T that fits into the upper suction pipe **105**. The lower protrusion **122**S of the lower cylinder **121**S is provided with a lower suction hole **135**S that fits into the lower suction pipe **104**.

As illustrated in FIG. **2**, the upper side of the upper cylinder chamber **130**T is closed by the upper end plate **160**T and the lower side of the upper cylinder chamber **130**T is closed by an intermediate partition plate **140**. The upper side of the lower cylinder chamber **130**S is closed by the intermediate partition plate **140** and the lower side the lower cylinder chamber **130**S is closed by the lower end plate **160**S.

When the upper vane **127**T is pressed by the upper spring **126**T to come into contact with the outer peripheral surface **139**T of the upper piston **125**T, the upper cylinder chamber **130**T is divided into an upper suction chamber **131**T communicating with the upper suction hole **135**T and the upper compression chamber **133**T communicating with an upper discharge hole **190**T provided on the upper end plate **160**T. When the lower vane **127**S is pressed by the lower spring **126**S to come into contact with the outer peripheral surface **139**S of the lower piston **125**S, the lower cylinder chamber **130**S is divided into a lower suction chamber **131**S communicating with the lower suction hole **135**S and the lower compression chamber **133**S communicating with a lower discharge hole **190**S provided on the lower end plate **160**S.

Furthermore, the upper discharge hole **190**T is provided in proximity to the upper vane slot **128**T, and the lower discharge hole **190**S is provided in proximity to the lower vane slot **128**S. The refrigerant compressed in the upper compression chamber **133**T is discharged from the upper compression chamber **133**T through the upper discharge hole **190**T. The refrigerant compressed in the lower compression chamber **133**S is discharged from the lower compression chamber **133**S through the lower discharge hole **190**S.

As illustrated in FIG. **2**, the upper end plate **160**T is provided with the upper discharge hole **190**T which penetrates the upper end plate **160**T to communicate with the upper compression chamber **133**T of the upper cylinder **121**T. On the outlet side of the upper discharge hole **190**T, an upper valve seat is formed around the upper discharge hole **190**T. The upper side of the upper end plate **160**T (on the side of the upper end plate cover **170**T) is provided with an upper discharge valve housing recess **164**T extending in a groove shape from the position of the upper discharge hole **190**T toward the outer periphery of the upper end plate **160**T.

The upper discharge valve housing recess **164**T houses an entire upper discharge valve **200**T of a reed valve type and an entire upper discharge valve retainer **201**T that regulates the opening of the upper discharge valve **200**T. A base end of the upper discharge valve **200**T is fixed in the upper discharge valve housing recess **164**T by an upper rivet **202**T, and a tip end of the upper discharge valve **200**T opens and closes the upper discharge hole **190**T. The base end of the upper discharge valve retainer **201**T overlaps the upper discharge valve **200**T and is fixed in the upper discharge valve housing recess **164**T by the upper rivet **202**T, and the tip end of the upper discharge valve retainer **201**T is curved (warped) in an opening direction of the upper discharge valve **200**T and regulates the opening of the upper discharge valve **200**T. Moreover, the upper discharge valve housing recess **164**T is formed to be slightly wider than the width of the upper discharge valve **200**T and the upper discharge valve retainer **201**T so as to house the upper discharge valve **200**T and the upper discharge valve retainer **201**T as well as performing positioning of the upper discharge valve **200**T and the upper discharge valve retainer **201**T.

The lower end plate **160**S is provided with the lower discharge hole **190**S penetrating the lower end plate **160**S to communicate with the lower compression chamber **133**S of the lower cylinder **121**S. On the outlet side of the lower discharge hole **190**S, a lower valve seat having an annular shape is formed around the lower discharge hole **190**S. The lower side of the lower end plate **160**S (on the side of the lower end plate cover **170**S) is provided with a lower discharge valve housing recess **164**S extending in a groove shape from the position of the lower discharge hole **190**S toward the outer periphery of the lower end plate **160**S (refer to FIG. **3**).

The lower discharge valve housing recess **164**S houses an entire lower discharge valve **200** of a reed valve type and an entire lower discharge valve retainer **201**S that regulates the opening of the lower discharge valve **200**S. A base end of the lower discharge valve **200**S is fixed in the lower discharge valve housing recess **164**S by a lower rivet **202**S, and a tip end of the lower discharge valve **200**S opens and closes the lower discharge hole **190**S. A base end of the lower discharge valve retainer **201**S overlaps the lower discharge valve **200**S and is fixed in the lower discharge valve housing recess **164**S by the lower rivet **202**S, and a tip end of the lower discharge valve retainer **201**S is curved (warped) in an opening direction of the lower discharge valve **200**S and regulates the opening of the lower discharge valve **200**. Moreover, the lower discharge valve housing recess **164**S is formed to be slightly wider than the width of the lower discharge valve **200**S and the lower discharge valve retainer **201**S so as to house the lower discharge valve **200**S and the lower discharge valve retainer **201**S as well as performing positioning of the lower discharge valve **200**S and the lower discharge valve retainer **201**S.

Furthermore, an upper end plate cover chamber **180**T is formed between the upper end plate **160**T and the upper end plate cover **170**T having the bulging part **181**, which are closely fixed to each other. A lower end plate cover chamber **180**S (refer to FIG. **1**) is formed between the lower end plate **160**S and the flat plate-shaped lower end plate cover **170**S, which are closely fixed to each other. As illustrated in FIG. **1**, the compression unit **12** has a refrigerant passage hole **136** penetrating the lower end plate **160**S, the lower cylinder **121**S, the intermediate partition plate **140**, the upper end plate **160**T, and the upper cylinder **121**T so as to communicate the lower end plate cover chamber **180**S with the upper end plate cover chamber **180**T.

A lower discharge chamber recess **163**S communicates with the lower discharge valve housing recess **164**S. The lower discharge chamber recess **163**S is formed to have the same depth as the lower discharge valve housing recess **164**S so as to overlap the lower discharge hole **190**S side of the lower discharge valve housing recess **164**S. The lower discharge hole **190**S side of the lower discharge valve housing recess **164**S is housed in the lower discharge chamber recess **163**S. The refrigerant passage hole **136** is disposed at a position of the lower discharge chamber recess **163**S and at a position communicating with the lower discharge chamber recess **163**S.

Furthermore, the lower surface of the lower end plate **160**S (a contact surface with the lower end plate cover **170**S) is provided with a plurality of bolt holes **138** to allow the passage of through bolts **175** or the like, at a region other than the region where the lower discharge chamber recess **163**S and the lower discharge valve housing recess **164**S are formed.

The refrigerant passage hole **136** is disposed at a position of an upper discharge chamber recess **163**T and at a position communicating with the upper discharge chamber recess **163**T. The upper discharge chamber recess **163**T and the upper discharge valve housing recess **164**T formed in the upper end plate **160**T are also formed in the shapes similar to the shapes of the lower discharge chamber recess **163**S and the lower discharge valve housing recess **164**S formed in the lower end plate **160**S, respectively. The upper end plate cover chamber **180**T is formed with the bulging part **181** having a dome shape on the upper end plate cover **170**T, the upper discharge chamber recess **163**T, and the upper discharge valve housing recess **164**T.

Hereinafter, a flow of the refrigerant generated by the rotation of the rotary shaft **15** will be described. In the upper cylinder chamber **130**T, the rotation of the rotary shaft **15** causes the upper piston **125**T fitted to the upper eccentric part **152**T of the rotary shaft **15** to revolve along the inner peripheral surface **137**T of the upper cylinder **121**T. This revolution causes the upper suction chamber **131**T to suck the refrigerant from the upper suction pipe **105** while expanding the volume and causes the upper compression chamber **133**T to compress the refrigerant while reducing the volume. When the pressure of the compressed refrigerant exceeds the pressure of the upper end plate cover chamber **180**T outside the upper discharge valve **200**T, the upper discharge valve **200**T opens and the refrigerant is discharged from the upper compression chamber **133**T to the upper end plate cover chamber **180**T. The refrigerant discharged to the upper end plate cover chamber **180**T is discharged into the compressor housing **10** through an upper end plate cover discharge hole **172**T (refer to FIG. **1**) provided on the upper end plate cover **170**T.

Moreover, in the lower cylinder chamber **130**S, the rotation of the rotary shaft **15** causes the lower piston **125**S fitted to the lower eccentric part **152**S of the rotary shaft **15** to revolve along the inner peripheral surface **137**S of the lower cylinder **121**S. This revolution causes the lower suction chamber **131**S to suck the refrigerant from the lower suction pipe **104** while expanding the volume and causes the lower compression chamber **133**S to compress the refrigerant while reducing the volume. When the pressure of the compressed refrigerant exceeds the pressure of the lower end plate cover chamber **180**S outside the lower discharge valve **200**S, the lower discharge valve **200**S opens and the refrigerant is discharged from the lower compression chamber **133**S to the lower end plate cover chamber **180**S. The refrigerant discharged to the lower end plate cover chamber **180**S passes through the refrigerant passage hole **136** and the upper end plate cover chamber **180**T so as to be discharged into the compressor housing **10** from the upper end plate cover discharge hole **172**T provided on the upper end plate cover **170**T.

The refrigerant discharged into the compressor housing **10** passes through a notch (not illustrated) provided on the outer periphery of the stator **111** to provide vertical communication, a gap (not illustrated) in the winding portion of the stator **111**, or a gap **115** (refer to FIG. **1**) between the stator **111** and the rotor **112**, so as to be guided to the upper portion of the motor **11**, and then is discharged from the discharge pipe **107** as a discharge unit disposed in the upper part of the compressor housing **10**.

(Characteristic Configuration of Rotary Compressor)

Next, a characteristic configuration of the rotary compressor **1** of the exemplary embodiment will be described. The present exemplary embodiment is characterized by an oil-supply structure that sucks up the lubricating oil **18** stored in the lower part of the compressor housing **10** and supplies the lubricating oil **18** to the sliding portion. FIG. **3** is a vertical cross-sectional view illustrating a main part of the compression unit **12** of the rotary compressor **1** of the exemplary embodiment. As illustrated in FIG. **3**, in the present exemplary embodiment, the lubricating oil **18** stored in the lower part inside the compressor housing **10** is sucked up from an oil-supply vertical hole **155** (described below) of the rotary shaft **15** (first oil-supply structure) while the lubricating oil **18** is sucked up along an oil-supply groove **166** (described below) provided in the sub bearing **161**S of the lower end plate **160**S (second oil-supply structure).

(Oil-Supply Structure of Rotary Shaft)

FIG. **4** is a vertical cross-sectional view illustrating the rotary shaft **15** of the rotary compressor **1** of the exemplary embodiment. As illustrated in FIGS. **3** and **4**, the oil-supply vertical hole **155** penetrating from the lower end to the upper end of the rotary shaft **15** is formed inside the rotary shaft **15** in the axial direction of the rotary shaft **15**. Furthermore, the rotary shaft **15** is provided with a first oil-supply lateral hole **156***a*, a second oil-supply lateral hole **156***b*, and a third oil-supply lateral hole **156***c*, each of which communicating with the oil-supply vertical hole **155**. The first oil-supply lateral hole **156***a*, the second oil-supply lateral hole **156***b*, and the third oil-supply lateral hole **156***c* extend in the radial direction of the rotary shaft **15**, so as to penetrate from the oil-supply vertical hole **155** to the outer peripheral surface of the rotary shaft **15**.

The first oil-supply lateral hole **156***a* is provided in the main shaft **153** at a position adjacent to the upper eccentric part **152**T. The second oil-supply lateral hole **156***b* is provided on the opposite side of the upper eccentric part **152**T in the circumferential direction of the rotary shaft **15** so as to face the upper eccentric part **152**T. The third oil-supply lateral hole **156***c* is provided on the opposite side of the lower eccentric part **152**S in the circumferential direction of the rotary shaft **15** so as to face the lower eccentric part **152**S.

The oil-supply vertical hole **155** sucks the lubricating oil **18** from the lower end of the rotary shaft **15** by the centrifugal pump action generated by the centrifugal force generated at the rotation of the rotary shaft **15**. The lubricating oil **18** sucked up from the lower end to the upper end of the oil-supply vertical hole **155** overflows from the upper end of the main shaft **153** of the rotary shaft **15** to the outer peripheral surface of the rotary shaft **15** and runs downward along the outer peripheral surface of the rotary shaft **15**, so as to be supplied to the main bearing **161**T and to the sliding portions below the main bearing **161**T.

In the rotary shaft **15** in the present exemplary embodiment, the first oil-supply lateral hole **156***a*, the second oil-supply lateral hole **156***b*, and the third oil-supply lateral hole **156***c* are provided only in the main shaft **153**, the upper eccentric part **152**T, and the lower eccentric part **152**S, whereas no oil-supply lateral hole is provided in the sub shaft **151**. That is, the first oil-supply lateral hole **156***a*, the second oil-supply lateral hole **156***b*, and the third oil-supply lateral hole **156***c* are provided at positions other than the position to face the oil-supply groove **166** (described below) when the rotary shaft **15** rotates. According to the present exemplary embodiment, a shaft hole **16151** of the sub bearing **161**S is constantly lubricated by the lubricating oil **18** sucked up by the oil-supply groove **166** described below. This makes it possible to omit the formation of the oil-supply lateral hole in the sub shaft **151**, and thus possible to suppress the reduction of the mechanical strength of the sub shaft **151** due to the formation of the oil-supply lateral hole.

(Oil-Supply Structure of the Sub Bearing on Lower End Plate)

FIGS. **5**A and **5**B are vertical cross-sectional views illustrating the oil-supply groove **166** of the sub bearing **161**S in the rotary compressor **1** of the exemplary embodiment. FIG. **6** is a schematic developed view illustrating an inner peripheral surface of the shaft hole **161S1** of the sub bearing **161**S in the rotary compressor **1** of the exemplary embodiment. For convenience of description, FIG. **6** uses a developed plan view of the cylindrical inner peripheral surface of the shaft hole **161S1**.

As illustrated in FIGS. **5**A, **5**B, and **6**, the inner peripheral surface of the shaft hole **161S1** of the sub bearing **161**S is provided with the oil-supply groove **166** having a helical shape that sucks up the lubricating oil **18** from a lower end **161**Sa to an upper end **161**Sb of the shaft hole **161S1** to supply the oil. When the rotary shaft **15** rotates in a rotating direction R, the sub bearing **161**S appears to rotate relatively in the opposite direction to the rotating direction R of the rotary shaft **15**. Here, the direction in which the oil-supply groove **166** is inclined with respect to the rotating direction R will be described when viewed with the rotating direction R of the rotary shaft **15** as the reference, rather than using the rotating direction of the sub bearing **161**S as the reference.

As illustrated in FIG. **6**, the oil-supply groove **166** is inclined with respect to the rotating direction R of the rotary shaft **15** and extends in the rotating direction R of the rotary shaft **15** from the lower end **161**Sa toward the upper end **161**Sb of the shaft hole **161S1**. In other words, the oil-supply groove **166** is formed helically around the rotary shaft **15**. The lubricating oil **18** in the oil-supply groove **166** is sucked up from the lower end **161**Sa to the upper end **161**Sb of the shaft hole **161S1** along the oil-supply groove **166** by the viscous pump action utilizing the viscosity of the lubricating oil **18** generated in the oil-supply groove **166**. Unlike the centrifugal pump action in the oil-supply vertical hole **155**, the oil-supply groove **166** that sucks up the lubricating oil **18** using the viscous pump action sucks up the lubricating oil **18** without being affected by the rotation speed of the rotary shaft **15**. Accordingly, it is possible to suppress the reduction of the supply amount of the lubricating oil **18** when the shaft diameter of the rotary shaft **15** is small or when the rotation number of the rotary shaft **15** is low.

(Position of Upper End and Lower End of Oil-Supply Groove)

FIG. **7** is a bottom plan view of the sub bearing **161**S of the lower end plate **160**S in the rotary compressor **1** of the exemplary embodiment. FIG. **8** is a top plan view of the sub bearing **161**S of the lower end plate **160**S in the rotary compressor **1** of the exemplary embodiment.

As illustrated in FIGS. **7** and **8**, when a rotation angle θ with respect to the circumferential direction of the lower end plate **160**S (the circumferential direction of the lower cylinder **121**S and the circumferential direction of the sub bearing **161**S) is 0° (360°) when the lower piston **125**S is located at the top dead center, a lower end **166***a* and an upper end **166***b* of the oil-supply groove **166** are formed within a range of the rotation angle θ of 0° or more and 180° or less in the circumferential direction of the shaft hole **161S1**. In other words, when the rotation angle θ of the position of the contact point between the lower piston **125**S and the lower vane **127**S when the lower vane **127**S contracts the lower spring **126**S most, that is, the position corresponding to the position of the lower vane **127**S in the circumferential direction of the lower end plate **160**S is 0°, the lower end **166***a* and the upper end **166***b* of the oil-supply groove **166** are disposed within the range of the rotation angle θ of 0° or more and 180° or less. As illustrated in FIG. **8**, the upper end **166***b* of the oil-supply groove **166**, that is, the outlet of the oil-supply groove **166** is formed within the range of the rotation angle θ of 0° or more and 900 or less in the circumferential direction of the shaft hole **161S1**. In addition, as illustrated in FIG. **7**, the lower end **166***a* of the oil-supply groove **166**, that is, the inlet of the oil-supply groove **166** is formed within the range of the rotation angle θ of 90° or more and 180° or less in the circumferential direction of the shaft hole **161S1**.

Here, the behavior of the rotary shaft **15** in the compression process will be described. In a partial range in the circumferential direction of the rotary shaft **15**, for example, in a range where the rotation angle θ is within the range of $180^\circ<\theta<360^\circ$, the load applied in the radial direction of the rotary shaft **15** in the compression process is relatively greater than in the range of $0^\circ\leq\theta\leq180^\circ$. This is because the rotary shaft **15** is slightly bent by the reaction force received from the lower compression chamber **133**S in the compression process. Therefore, when the angle is in the range of $180^\circ<\theta<360^\circ$, the rotary shaft **15** is pressed toward the shaft hole **161S1** side of the sub bearing **161**S, leading to the high likelihood of occurrence of contact between the outer peripheral surface of the rotary shaft **15** and the inner peripheral surface of the shaft hole **161S1** of the sub bearing **161**S. On the other hand, the oil-supply groove **166** is formed by cutting the inner peripheral surface of the shaft hole **161S1** of the sub bearing **161**S, and this leads to formation of an edge at the corner of the oil-supply groove **166**. In addition, burrs (residual protrusions) generated during cutting are likely to remain in the oil-supply groove **166**. Together with the high likelihood of occurrence of the situation in which the corner edge of the oil-supply groove **166** comes into contact with the outer peripheral surface of the rotary shaft **15**, the sliding resistance between the shaft hole **161S1** of the sub bearing **161**S and the rotary shaft **15** is likely to locally increase at the edge portion of the oil-supply groove **166**. This would cause the lack of the lubricating oil **18** at the edge portion, leading to a risk of seizure between the edge portion and the rotary shaft.

To handle this, as described above, by disposing the oil-supply groove **166** within the rotation angle θ range of 0°≤θ≤180° in the circumferential direction of the shaft hole **161S1** of the sub bearing **161**S, it is possible to avoid a situation in which the corner edge of the oil-supply groove **166** comes into contact with the outer peripheral surface of the rotary shaft **15** when the outer peripheral surface of the rotary shaft **15** is pressed against the inner peripheral surface of the shaft hole **161S1** in the compression process of the compression unit **12**. This can avoid the local increase of the load at the edge of the oil-supply groove **166**, making it possible to ensure the reliability in supply conditions of the lubricating oil **18** to the sliding portion of the sub bearing **161**S.

Furthermore, the amount of lubricating oil **18** supplied from the oil-supply groove **166** to the sub bearing **161**S is the amount of lubricating oil **18** supplied from the oil-supply vertical hole **155** to the main bearing **161**T, or more. In other words, the depth and width of the oil-supply groove **166** and an inclination angle formed by the longitudinal direction of the oil-supply groove **166** with respect to the end surface the lower end **161**Sa of the shaft hole **161**S1 are set so that the supply amount of the lubricating oil **18** obtained by the oil-supply groove **166** becomes the total supply amount fed through the oil-supply vertical hole **155** of the rotary shaft **15**, or more. With this configuration, the amount of lubricating oil **18** that is the amount of lubricating oil **18** supplied to the main bearing **161**T and the upper cylinder **121**T through the oil-supply vertical hole **155** will be properly supplied to the sub bearing **161**S and the lower cylinder **121**S by the oil-supply groove **166**.

Furthermore, although one oil-supply groove **166** is provided in the sub bearing **161**S in the present exemplary embodiment, for example, a plurality of the oil-supply grooves **166** may be provided at mutually shifted positions in the circumferential direction of the shaft hole **161S1**. The supply amount of the lubricating oil **18** by the oil-supply groove **166** is affected by the viscosity of the lubricating oil **18** in the oil-supply groove **166**. Therefore, when it is difficult to obtain a desired supply amount by one oil-supply groove **166**, it would be possible to easily obtain a desired supply amount with the plurality of oil-supply grooves **166**.

While the exemplary embodiment is a case where the rotary shaft **15** includes the oil-supply vertical hole **155** and oil-supply lateral holes **156***a* to **166***c*, the present invention is not limited to the configuration including the oil-supply vertical hole **155** and oil-supply lateral holes **156***a* to **166***c*, and may be configured to supply the lubricating oil **18** only by the oil-supply groove **166** of the sub bearing **161**S.

Furthermore, an oil supply blade (not illustrated) that sucks up the lubricating oil **18** may be provided on the lower end side of the oil-supply vertical hole **155** of the rotary shaft **15**. The oil supply blade is formed by twisting a thin metal plate around the axis of the rotary shaft **15** and is fitted into the inner peripheral surface of the oil-supply vertical hole **155**. By using the oil supply blade, the supply amount of the lubricating oil **18** through the oil-supply vertical hole **155** can be ensured further stably.

(Flow of Lubricating Oil)

A flow of the lubricating oil **18** will be described below. With the rotation of the rotary shaft **15**, the lubricating oil **18** is sucked up from the lower end of the rotary shaft **15** through the oil-supply vertical hole **155**. The lubricating oil **18** passing through the oil-supply vertical hole **155** flows from the oil-supply vertical hole **155** and passes through the first oil-supply lateral hole **156***a*, the second oil-supply lateral hole **156***b*, and the third oil-supply lateral hole **156***c* to be supplied to the sliding surface between the main bearing **161**T and the main shaft **153** of the rotary shaft **15**, the sliding surface between the lower eccentric part **152**S of the rotary shaft **15** and the lower piston **125**S, and the sliding surface between the upper eccentric part **152**T and the upper piston **125**T, thereby lubricating each of the sliding surfaces.

In addition, together with the rotation of the rotary shaft **15**, the lubricating oil **18** is sucked up from the lower end **161**Sa to the upper end **161**Sb of the shaft hole **161**S1 of the sub bearing **161**S through the oil-supply groove **166** of the sub bearing **161**S. The lubricating oil **18** that has passed through the oil-supply groove **166** is supplied to the sliding surface between the sub bearing **161**S and the sub shaft **151** of the rotary shaft **15**, and the sliding surface between the lower eccentric part **152**S of the rotary shaft **15** and the lower piston **125**S, thereby lubricating each of the sliding surfaces. In addition, the lubricating oil **18** is supplied by the oil-supply vertical hole **155** and the oil-supply groove **166** as described above, whereby the sliding portions of the upper cylinder **121**T and the lower cylinder **121**S are sealed by the lubricating oil **18**.

As described above, the lower end plate **160**S of the rotary compressor **1** of the exemplary embodiment has a configuration in which the oil-supply groove **166** having a helical shape, which supplies the lubricating oil **18** from the lower end **161**Sa to the upper end **161**Sb of the shaft hole **161**S1, is formed on the inner peripheral surface of the shaft hole **161**S1 of the sub bearing **161**S. The oil-supply groove **166** is inclined with respect to the rotating direction R of the rotary shaft **15** and extends from the lower end **166***a* to the upper end **166***b* in the rotating direction R of the rotary shaft **15**. In a case where the shaft diameter of the rotary shaft **15** is small or where the rotation speed of the rotary shaft **15** is low at the time of supplying the lubricating oil **18** through the oil-supply vertical hole **155** of the rotary shaft **15**, the centrifugal force generated in the lubricating oil **18** inside the oil-supply vertical hole **155** of the rotary shaft **15** is reduced, leading to a decrease in the amount of the lubricating oil **18** sucked up through the oil-supply vertical hole **155**. In contrast, the exemplary embodiment has a configuration in which the oil-supply groove **166** provided in the sub bearing **161**S sucks up the lubricating oil **18** by the viscous pump action that is not affected by the rotation number of the rotary shaft **15**. Accordingly, even when the shaft diameter of the rotary shaft **15** is small or the rotation speed of the rotary shaft **15** is low, the lubricating oil **18** can be stably supplied to the sliding portions such as the sub bearing **161**S without depending on the centrifugal force of the rotary shaft **15**. Furthermore, with the presence of the oil-supply groove **166**, it is possible to ensure a sufficient amount of lubricating oil **18** to be supplied to the compression unit **12**. This makes it possible to improve sealability particularly in the gaps in each of sliding portions (for example, gap between the lower end plate **160**S and the lower piston **125**S, and between the intermediate partition plate **140** and the lower piston **125**S) in the height direction (axial direction of the rotary shaft **15**) of the compression unit **12**, leading to suppression of the deterioration in compression efficiency of the rotary compressor **1**.

In addition, compared with the fact that the height at which the lubricating oil **18** can be sucked up by the oil-supply vertical hole **155** is about the surface level of the lubricating oil **18** in the compressor housing **10**, the oil-supply groove **166** makes it possible to suck up the lubricating oil **18** by utilizing the viscous pump action as long as the surface level of the lubricating oil **18** reaches the lower end **166***a* of the oil-supply groove **166**. Therefore, even when the surface level of the lubricating oil **18** becomes low after the lubricating oil **18** is discharged together with the refrigerant from the inside of the compressor housing **10**, the oil-supply groove **166** can properly supply the lubricating oil **18** to each of the sliding portions of the sub bearing **161**S and the lower cylinder **121**S. Consequently, the oil-supply groove **166** can improve the stability of the supply conditions to the sliding portion. Furthermore, by forming the oil-supply groove **166** in the shaft hole **161S1** of the sub bearing **161**S, it is possible to easily process the oil-supply groove **166** as compared with the case where the oil-supply groove **166** is formed in the rotary shaft **15** having high hardness.

Furthermore, in the lower end plate **160**S of the rotary compressor **1** of the exemplary embodiment, when the rotation angle θ with respect to the circumferential direction of the lower end plate **160**S is 0° when the lower piston **125**S is located at the top dead center, the lower end **166***a* and the upper end **166***b* of the oil-supply groove **166** are formed within the range of the rotation angle θ of 0° or more and 180° or less in the circumferential direction of the shaft hole **161S1**. This configuration makes it possible to avoid a situation in which the rotary shaft **15** is pressed against the shaft hole **161S1** in the compression process of the compression unit **12** causing the corner edges of the oil-supply groove **166** to come into contact with the outer peripheral surface of the rotary shaft **15** and locally increasing the load on the edge. Accordingly, the reliability of the supply conditions of the lubricating oil **18** to the sliding portion of the sub bearing **161**S is ensured thereby avoiding occurrence of the seizure at the sub bearing **161**S.

Furthermore, the rotary shaft **15** of the rotary compressor **1** of the exemplary embodiment is provided with the first oil-supply lateral hole **156***a*, the second oil-supply lateral hole **156***b* and the third oil-supply lateral hole **156***c* at positions other than the position to face the oil-supply groove **166** when the rotary shaft **15** rotates. Since the shaft hole **161S1** of the sub bearing **161**S is constantly lubricated by the lubricating oil **18** sucked up by the oil-supply groove **166**, it possible to omit the formation of the oil-supply lateral hole in the sub shaft **151**. This makes it possible to suppress deterioration of the mechanical strength of the sub shaft **151** due to the formation of the oil-supply lateral hole.

In addition, in the rotary compressor **1** of the exemplary embodiment, the amount of lubricating oil **18** supplied from the oil-supply groove **166** to the sub bearing **161**S is the amount of the lubricating oil **18** supplied from the oil-supply vertical hole **155** to a main bearing **166**T, or more. With this configuration, the amount of lubricating oil **18**, which is the amount of lubricating oil **18** supplied to the main bearing **161**T and the upper cylinder **121**T through the oil-supply vertical hole **155**, or more, will be properly supplied to the sliding portions of the sub bearing **161**S and the lower cylinder **121**S by the oil-supply groove **166**.

While the above-described exemplary embodiment is an exemplary configuration applied to the two-cylinder type rotary compressor, the present invention is not limited to the two-cylinder type and may be applied to a one-cylinder type rotary compressor.

REFERENCE SIGNS LIST

1 ROTARY COMPRESSOR
10 COMPRESSOR HOUSING
11 MOTOR
12 COMPRESSION UNIT
15 ROTARY SHAFT
18 LUBRICATING OIL
105 UPPER SUCTION PIPE (SUCTION UNIT)
104 LOWER SUCTION PIPE (SUCTION UNIT)
107 DISCHARGE PIPE (DISCHARGE UNIT)
121T UPPER CYLINDER
121S LOWER CYLINDER
125T UPPER PISTON
125S LOWER PISTON
130T UPPER CYLINDER CHAMBER
130S LOWER CYLINDER CHAMBER
151 SUB SHAFT
152T UPPER ECCENTRIC PART
152S LOWER ECCENTRIC PART
153 MAIN SHAFT
155 OIL-SUPPLY VERTICAL HOLE
156*a* FIRST OIL-SUPPLY LATERAL HOLE
156*b* SECOND OIL-SUPPLY LATERAL HOLE
156*c* THIRD OIL-SUPPLY LATERAL HOLE
160T UPPER END PLATE
160S LOWER END PLATE
161T MAIN BEARING
161S SUB BEARING
161S1 SHAFT HOLE
161 Sa LOWER END
161 Sb UPPER END
166 OIL-SUPPLY GROOVE
166*b* UPPER END
166*a* LOWER END
R ROTATING DIRECTION
θ ROTATION ANGLE

The invention claimed is:

1. A rotary compressor comprising:
- a compressor housing hermetically sealed, having a cylindrical shape to be vertically arranged, being provided with a discharge unit and a suction unit of refrigerant, and configured to store lubricating oil in a lower part of the compressor housing;
- a compression unit disposed at a lower part of the compressor housing and configured to compress the refrigerant sucked from the suction unit and discharge the compressed refrigerant from the discharge unit; and
- a motor disposed on an upper part of the compressor housing and configured to drive the compression unit,

wherein the compression unit includes:
- a cylinder having an annular shape;
- an upper end plate that closes an upper side of the cylinder;
- a lower end plate that closes a lower side of the cylinder;
- a main bearing provided on the upper end plate;
- a sub bearing provided on the lower end plate;

a rotary shaft supported by the main bearing and the sub bearing so as to be rotated by the motor; and

a piston having an annular shape, and configured to be fitted to an eccentric part of the rotary shaft and to revolve along an inner peripheral surface of the cylinder so as to form a cylinder chamber within the cylinder,

wherein the rotary shaft comprises a first oil-supply path configured to suck up the lubricating oil from a lower end of the rotary shaft, the first oil-supply path having an oil-supply vertical hole extending from the lower end of the rotary shaft in an axial direction and an oil-supply lateral hole extending in a direction intersecting the oil-supply vertical hole inside the rotary shaft, and

wherein the sub bearing comprises a second oil-supply path configured to suck up the lubricating oil from a lower end of the sub bearing, the second oil-supply path being provided in an inner peripheral surface of a shaft hole of the sub bearing and having a helical oil-supply groove supplying the lubricating oil from a lower end to an upper end of the shaft hole, the oil-supply groove being inclined with respect to the rotary shaft in a rotating direction and extending from the lower end toward the upper end of the shaft hole in the rotating direction of the rotary shaft.

2. The rotary compressor according to claim **1**,

wherein, when a rotation angle with respect to a circumferential direction of the lower end plate is 0° when the piston is located at a top dead center, the lower end and the upper end of the oil-supply groove are formed within a range of the rotation angle θ of 0° or more and 180° or less at the shaft hole in a circumferential direction.

3. The rotary compressor according to claim **1**, wherein the rotary shaft internally includes: an oil-supply vertical hole extending from the lower end of the rotary shaft in an axial direction; and an oil-supply lateral hole extending in a direction intersecting the oil-supply vertical hole.

4. The rotary compressor according to claim **3**,

wherein the oil-supply lateral hole is provided only at a position other than a position to face the oil-supply groove when the rotary shaft rotates.

5. The rotary compressor according to claim **2**,

wherein the rotary shaft internally includes: an oil-supply vertical hole extending from a lower end of the rotary shaft in an axial direction; and an oil-supply lateral hole extending in a direction intersecting the oil-supply vertical hole.

6. The rotary compressor according to claim **5**,

wherein the oil-supply lateral hole is provided only at a position other than a position to face the oil-supply groove when the rotary shaft rotates.

7. The rotary compressor according to claim **1**,

wherein an upper end of the oil-supply groove is formed within a range of the rotation angle of 0° or more and 90° or less, and

an lower end of the oil-supply groove is formed within a range of the rotation angle of 90° or more and 180° or less.

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